

THURSDAY, AUGUST 24, 1905.

SCHOOL MATHEMATICS.

Easy Graphs. By H. S. Hall, M.A. Pp. vii+64. (London: Macmillan and Co., Ltd., 1905.) Price 1s.

The Rudiments of Practical Mathematics. By A. Consterdine, M.A., and A. Barnes, M.A. Pp. xv+332. (London: John Murray, 1905.) Price 2s. 6d.

Elementary Practical Mathematics. By H. A. Stern, M.A., and W. H. Topham. Pp. viii+110+vi. (London: George Bell and Sons.)

A First Algebra. By W. M. Baker, M.A., and A. A. Bourne, M.A. Pp. x+176+xxxv. (London: George Bell and Sons, 1905.) Price 2s.

Algebraical Grounding. By D. E. Shorto, M.A. Pp. 46. (London: Rivington, 1905.) Price 1s. net.

Examples in Algebra. By Charles M. Clay. Pp. vii+372. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1905.) Price 4s. net.

Geometrical Conics. By G. W. Caunt, M.A., and C. M. Jessop, M.A. Pp. vi+80. (London: Edward Arnold.) Price 2s. 6d.

THE little book on "Easy Graphs," by Mr. H. S. Hall, is the result of ripe experience, and is intended to lead the beginner by very easy stages and show him all the points that require special attention in squared paper work and the lessons to be learnt therefrom. Great attention is paid to the suitable choice of scales and the proper figuring of the diagrams. Linear graphs with inferences and applications occupy fully half the book, the latter half relating to algebraical equations and graphs of the second degree with one or two cubics. The numerous examples are interesting and suggestive, and all the answers are given at the end. We agree with the author in deprecating the undue employment of graphs, especially as the field in which they may be legitimately used is sufficiently extensive. The book will be deservedly popular.

The "Rudiments of Practical Mathematics," by Messrs. Consterdine and Barnes, is a very excellent treatise, intended more particularly for students above twelve years of age who are preparing for industrial pursuits. The heuristic method is in the main followed, and the material for exercises is largely drawn from the students' own measurements, suitable objects of a simple kind being provided for this purpose, with appliances for measuring lengths, areas, volumes, weights, and times. Thus every rule and process is definitely associated with some direct quantitative application, and the subject assumes a real and living interest and cannot fail to be assimilated. The subject-matter is purposely confined to that which is in daily use in industrial occupations, so that there is time for this to be dealt with in a very thorough manner. In this volume arithmetic, algebra, and geometry are so interwoven that any attempt at separation would appear quite unnatural. Thus when an important principle, say that of proportion, is

under review it can be studied and developed with the completeness which its importance demands, arithmetically, algebraically, and geometrically. Students are taught the use of logarithms, and also sufficient trigonometry to enable them to solve right-angled triangles; they use compasses and setsquares, draw simple plans and elevations, and make dimensioned free-hand sketches in pictorial or other projection, and they are introduced to the notion of a vector by means of displacement and velocity diagrams. In some places there may be an insufficient number of examples for the purposes of drill, but altogether the subject is admirably developed and presented; the book is well adapted to its purpose, and its wide adoption would have a very beneficial effect.

The "Elementary Practical Mathematics," by Messrs. Stern and Topham, is a preliminary volume comprising the first nine chapters of a more complete text-book on which the authors are engaged. It relates to physical measurement with exercises based thereon, including the measurements of length, angles, mass, area, volume, specific gravity, with the practical calibration of certain glass vessels. The two first chapters deal with contracted arithmetical processes and squared paper work, but otherwise a knowledge of "theoretical" mathematics is assumed. The work is intended as a first course for the junior forms of schools, and especially for boys preparing for army examinations. The apparatus is fairly comprehensive, and the experiments are well described. The book will be very useful to those arranging a course in an important branch of practical mathematics.

The "First Algebra," by Messrs. Baker and Bourne, is adapted from the first part of the authors' larger work, and, proceeding in the customary order, carries the subject up to quadratic equations and fractional and negative indices. Arithmetical and graphical illustrations are freely introduced, and a special feature of the work is its very easy graduation and the large number of examples, some oral, provided at every stage, so that students using the book properly cannot fail to obtain a full knowledge of the subject. The answers are completely given, and themselves extend to thirty-five pages. The book gives an admirable first course in algebra.

Mr. Shorto's "Algebraical Grounding" is a collection of the definitions, axioms, laws, rules, and proofs belonging to the subject, without examples, and arranged in logical sequence. It is intended as a summary of the oral teaching usually imparted, and could well be used in conjunction with a collection of examples. It includes logarithms, the progressions, and the binomial theorem.

The collection of eight thousand "Examples in Algebra," by Mr. Clay, has been accumulating for the last twenty years, during which time the author has been engaged in teaching the subject in America, and has found that the examples provided in the ordinary text-books are deficient in both quantity and variety, and not regularly graded. The teacher will here find examples in superabundance, increasing in difficulty by almost insensible steps from the simpler

exercises in the use of symbols to the difficult problems in surds, theory of exponents, quadratics, and in arithmetical and geometrical progressions. The work shows no trace of having been influenced by the reform movement going on in this country, but teachers will receive valuable hints and much useful matter by consulting this thorough and extensive compilation.

The "Geometrical Conics" by Messrs. Caunt and Jessop is a preliminary deductive course for students about to enter on a systematic study of analytical geometry. Only the leading properties of conics are dealt with, and these are established when possible from corresponding properties of the circle by the aid of the modern methods of projection. The book is well suited to its purpose.

PANAMA CANAL.

Problems of the Panama Canal. By Brig.-General Henry L. Abbot, U.S. Army. Pp. xi+248. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1905.) Price 6s. 6d. net.

THE author of this book acquired distinction in hydraulics in early life by the publication, in conjunction with Captain Humphreys, of their well-known "Report on the Physics and Hydraulics of the Mississippi River" in 1861; and, accordingly, this statement of the problems of the Panama Canal, in which hydraulics are so largely involved, by such a high authority, who, as a member of the technical committee of the New Panama Company, devoted seven years to their study, deserves the most careful consideration of the American nation, for whose guidance this volume has been published. It appears at a very opportune time, when the United States Government has undertaken the completion of the works, but has entrusted to a commission of engineers the consideration of the precise designs for the canal.

The chapters on the "New Panama Company," with which the author was connected, "The Rival Routes" of Panama and Nicaragua, the "Physical Conditions of the Isthmus," "The Chagres River," with its torrential floods and difficulty of control, and the "Disposal of Rainfall," all present features of interest, and the last three are essential in a study of the works to be carried out; but undoubtedly the most interesting portion of the book for the British public and engineers generally is contained in the final chapter on "Projects for the Canal." It will be remembered that when M. de Lesseps started the scheme about twenty-five years ago he proposed the construction of a tide-level canal; and the works were commenced on this basis with very inadequate investigations of the nature of the strata to be traversed by the cuttings, especially through the Culebra ridge, and the physical conditions of the locality. When experience had proved the unexpected magnitude of the undertaking, and the unforeseen difficulties to be overcome, the original company, approaching the end of its resources, decided in 1887 to introduce locks, thereby greatly reducing the amount of excavation,

and also the time required for the completion of the canal. Eventually, after the failure of the first company, a New Panama Company was formed in 1894 (given by a misprint as 1904 in the introduction); and the works for a canal with locks were slowly proceeded with as funds permitted, until at length, last year, the United States Government purchased the undertaking with the view of carrying it out as a national work. Early this year an engineering committee of the Panama Commission recommended a sea-level canal again, with a bottom-width of 150 feet and a minimum depth of 35 feet, and the necessary duplicate tidal locks near the Panama end, capable of accommodating vessels up to 1000 feet in length and 100 feet in width.

The principal objections to the formation of a canal across the isthmus at sea-level throughout, are the time, difficulties, and cost involved in making a cutting, reaching a depth of 317 feet, in unfavourable strata exposed to tropical rains, and the efficient control of the River Chagres, which crosses the line of the canal on the Atlantic slope in several places, and the floods of which will become a more serious peril to the maintenance of the canal in proportion as the water-level of the canal is lowered. The objection of cost, and, to some extent, that of time, are of considerably less importance in a national than in a private undertaking; but the floods of the Chagres appear liable to prove a standing menace to the safety of a tide-level canal. The Isthmian Canal Commission of 1899-1901 expressed its disapproval of a sea-level project in the following words:—

"The cost of such a canal, including a dam at Alhajuela, and a tide lock at Miraflores near the Pacific end, is estimated at not less than 240,000,000 dollars. Its construction would probably take at least twenty years. This Commission concurs with the various French Commissions which have preceded it, since the failure of the Old Company, in rejecting the sea-level plan. While such a plan would be physically practicable, and might be adopted if no other solution were available, the difficulties of all kinds, and especially those of time and cost, would be so great that a canal with a summit level reached by locks is to be preferred."

The author regards these remaining difficulties as very important; and, after discussing them, and particularly the problems concerning the control of the Chagres, he concludes his book with the following expression of his opinions:—

"It is the unanimous opinion of all the engineers who have had practical experience in canal work, and time to thoroughly study the problem, that no sea-level *projet* without locks, and no sea-level canal even with a tidal lock, is practicable that would be comparable in ease and safety of transit to one equipped with modern locks, and planned to take advantage of all the desirable elements which the natural conditions offer. Why, then, waste an extra ten or a dozen years, and untold millions of dollars, to execute a scheme which the investigations of thirty-five years have demonstrated to possess only a sentimental merit due to the imagination of M. de Lesseps? Congress and the American people are impatient for the opening of the best possible canal."